ICTV Virus Taxonomy Profile: Rhabdoviridae

Peter J. Walker,1,* Kim R. Blasdell,2 Charles H. Calisher,3 Ralf G. Dietzgen,4 Hideki Kondo,5 Gael Kurath,6 Ben Longdon,7 David M. Stone,8 Robert B. Tesh,9 Noël Tordo,10 Nikos Vasilakis,9 Anna E. Whitfield11 and ICTV Report Consortium

Abstract

The family Rhabdoviridae comprises viruses with negative-sense (−) single-stranded RNA genomes of 10.8–16.1 kb. Virions are typically enveloped with bullet-shaped or bacilliform morphology but can also be non-enveloped filaments. Rhabdoviruses infect plants and animals including mammals, birds, reptiles and fish, as well as arthropods which serve as single hosts or act as biological vectors for transmission to animals or plants. Rhabdoviruses include important pathogens of humans, livestock, fish and agricultural crops. This is a summary of the International Committee on Taxonomy of Viruses (ICTV) Report on the taxonomy of Rhabdoviridae, which is available at www.ictv.global/report/rhabdoviridae.

Table 1. Characteristics of the family Rhabdoviridae

<table>
<thead>
<tr>
<th>Typical member: vesicular stomatitis Indiana virus (AF473864), species Indiana vesiculovirus, genus Vesiculovirus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virion</td>
</tr>
<tr>
<td>Genome</td>
</tr>
<tr>
<td>Replication</td>
</tr>
<tr>
<td>Translation</td>
</tr>
<tr>
<td>Host range</td>
</tr>
<tr>
<td>Taxonomy</td>
</tr>
</tbody>
</table>

VIRION

Virions are usually enveloped and bullet-shaped or bacilliform (i.e. with two rounded ends) and contain five structural proteins (Table 1, Fig. 1). The nucleocapsid protein (N), the large multi-functional RNA-dependent RNA polymerase (L) and the polymerase-associated phosphoprotein (P) together with the RNA genome form the ribonucleoprotein (RNP) complex. The nucleocapsid is encased in the matrix protein (M) layer which also interacts with the envelope containing the transmembrane glycoprotein (G). Plant rhabdoviruses assigned to the genus Varicosavirus are filamentous and lack an envelope.

GENOME

Rhabdovirus negative sense (−) single-stranded RNA genomes range from 10.8 to 16.1 kb [1]. Almost all rhabdovirus genomes are unsegmented but rhabdoviruses with bi-segmented genomes are also known [2]. Terminal non-coding regions are partially complementary. Genomes usually encode five major structural proteins but may also encode additional (accessory) proteins either in additional genes or as alternative ORFs within the structural protein genes (Fig. 2) [1, 3].

REPLICATION

Rhabdovirus replication generally occurs in the cytoplasm following receptor-mediated endocytosis. Primary
transcription is initiated from the incoming (−)RNP complex by the RNA-dependent RNA polymerase (RdRP). Stop–start transcription occurs 3′ to 5′ using gene start and gene end sequences, separated by non-transcribed intergenic sequences, to generate capped and polyadenylated mRNAs. Replication is initiated by the RdRP from a single promoter at the 3′ end, ignoring gene start and end sequences to generate a (+)RNP. This is the template to generate nascent (−)RNP which are assembled with M and G into enveloped virions. Budding can occur at either the plasma membrane or internal membranes. Some plant rhabdoviruses replicate in the nucleus.

Fig. 2. Schematic representation of rhabdovirus genome organization, exemplifying variations in architecture and the number and location of accessory genes. Arrows indicate the position of long ORFs. Alternative ORFs occur within some genes; only ORFs (≥180 nt) that appear likely to be expressed are shown. ORFs encoding viroporin (yellow) and movement proteins (blue) are shown.

TAXONOMY

The Rhabdoviridae includes 18 genera and one unassigned species (Moussa virus). Viruses assigned to each genus form a monophyletic clade based on phylogenetic analyses of L protein sequences and usually have similar genome organizations, including the number and locations of accessory genes. Rhabdoviruses have been isolated from a wide range of vertebrates and plants; many have been isolated from arthropods [4, 5]. Members of the genus Lyssavirus infect only mammals, including humans in which they can cause fatal encephalitis (rabies). Members of the genera Vesiculovirus, Ephemerovirus, Tiboivirus, Hapavirus, Curivirius, Sri-puvirus and Ledantevirus infect vertebrates (mammals, birds or reptiles) and are transmitted by arthropods. Some arthropod-borne rhabdoviruses are associated with diseases of livestock; some may cause disease in humans. Members of the genus Tupavirus have only been isolated from vertebrates. Members of the genera Novirhabdovirus, Sprivivirus and Perhabdovirus infect only fish, some causing economically important diseases. Rhabdoviruses assigned to the genus Signavirus each infect only dipteran flies of a single species and are transmitted vertically. Members of the genus Almendravirus replicate only in insects. Plant rhabdoviruses are assigned to the genera Cytorhabdovirus, Nucleorhabdovirus, Dichorhavirus and Varicosavirus and are transmitted by either arthropods or chytrid fungi. Many are associated with diseases of agricultural or horticultural importance.

REFERENCES